JWST IAC Workshop-GO1 Proposal Planning

The Cosmic Evolution Early Release Science (CEERS) Survey

Pablo G. Pérez-González (UCM, EC-MIRI)
on behalf of the CEERS Team

CENTRO DE ASTROBIOLOGÍA
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE

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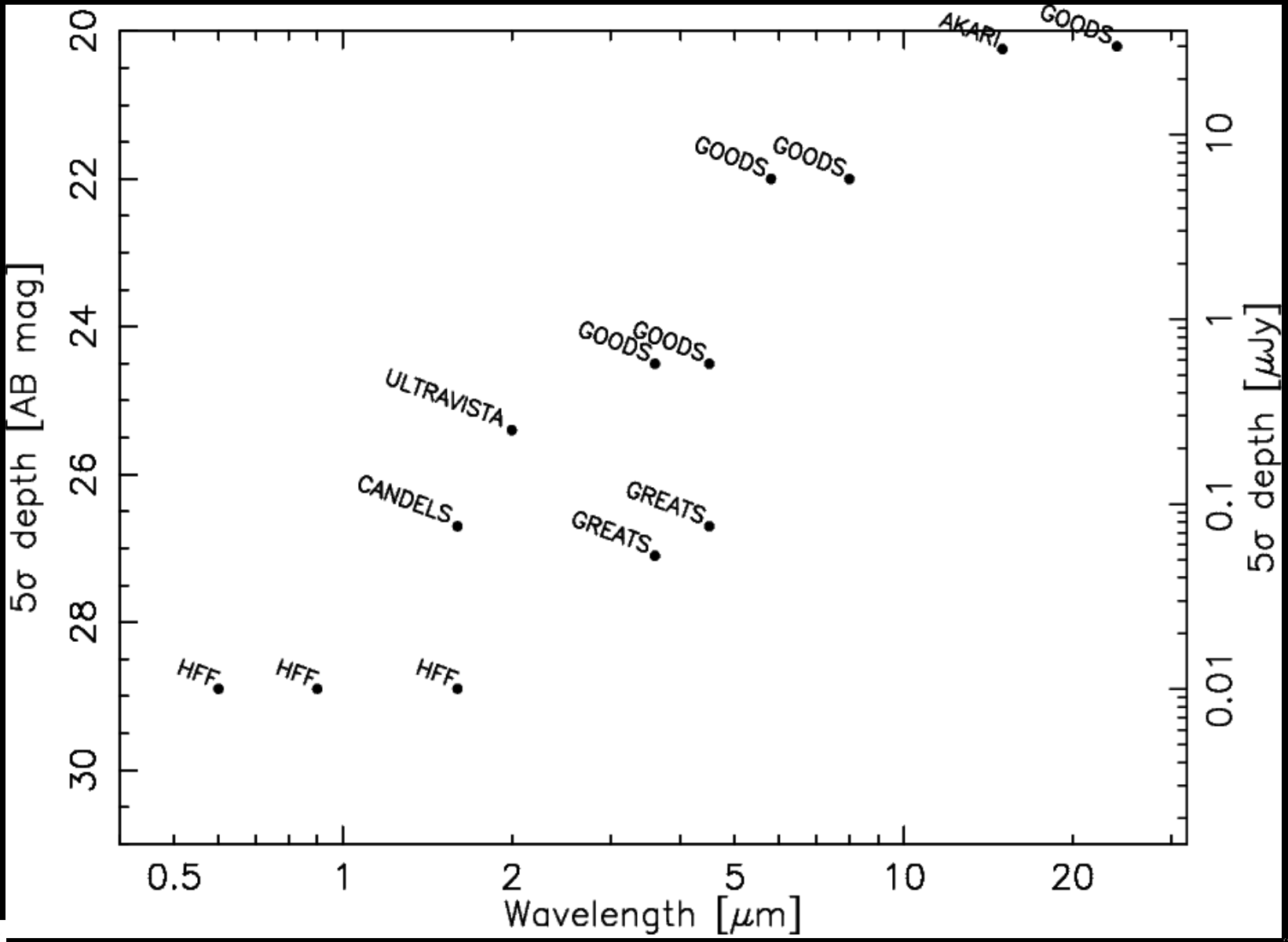
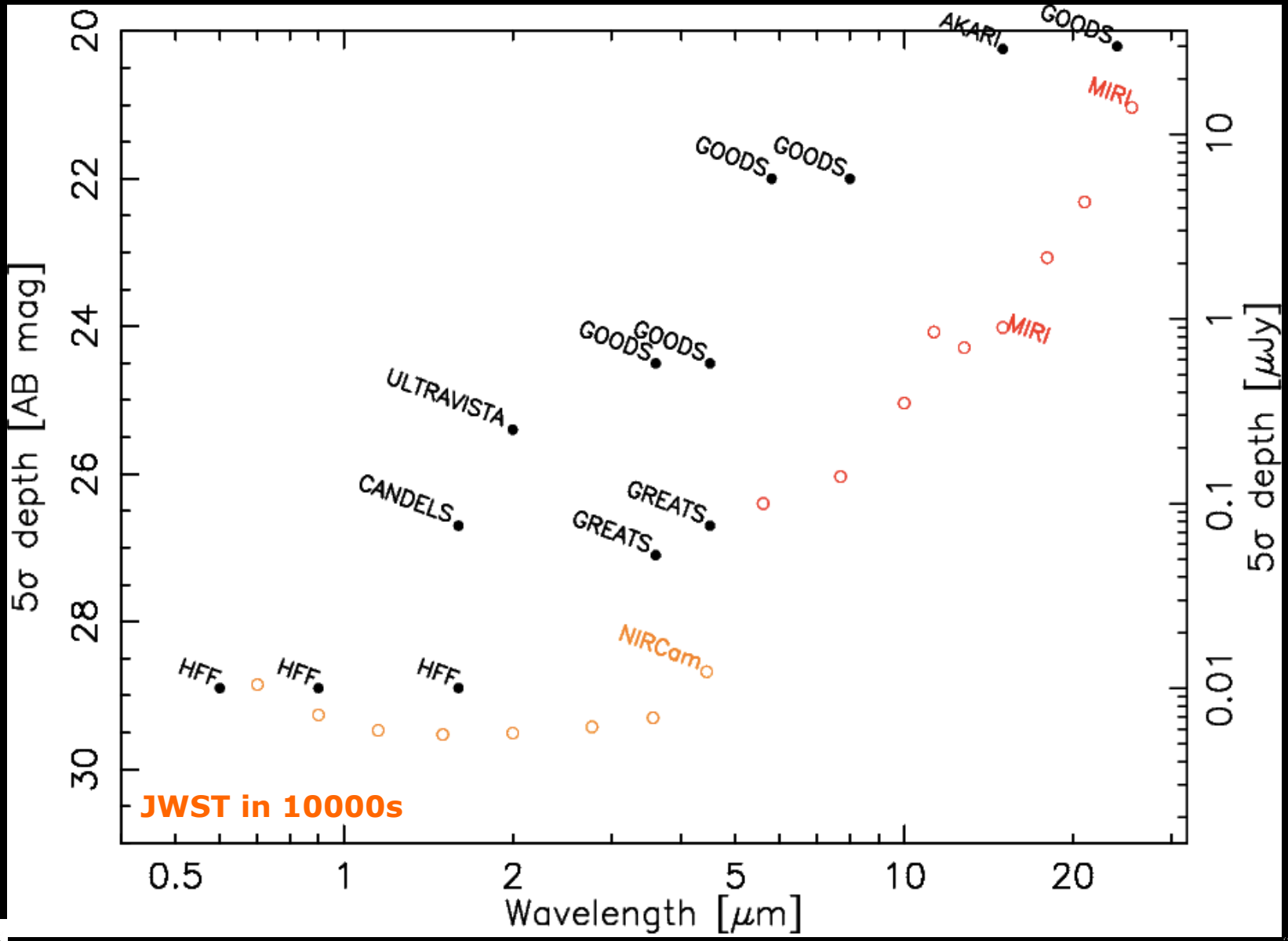
Universidad Complutense de Madrid, Spain
EC-MIRI

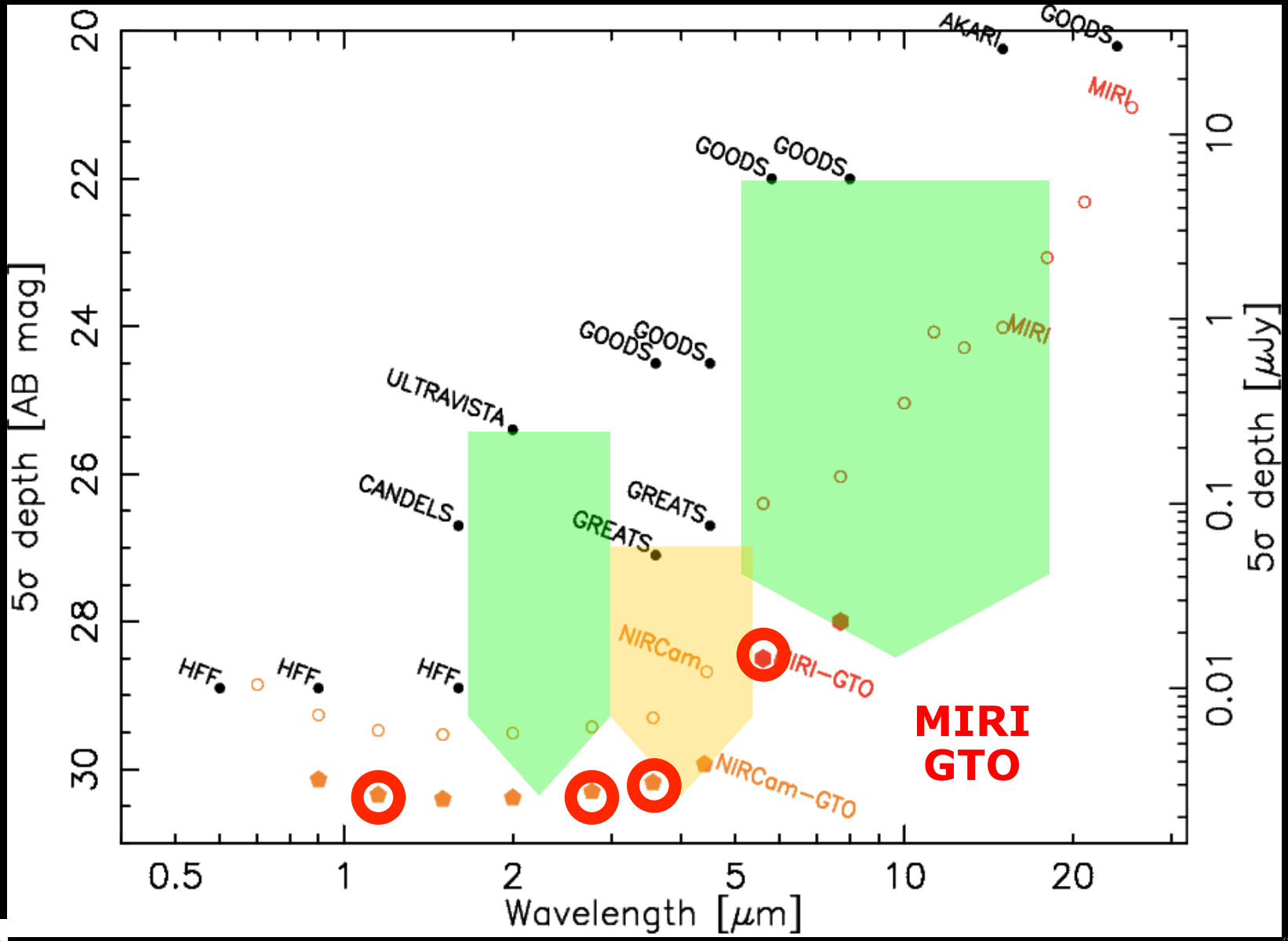
Pre-JWST (HST, Spitzer, AKARI) imaging surveys



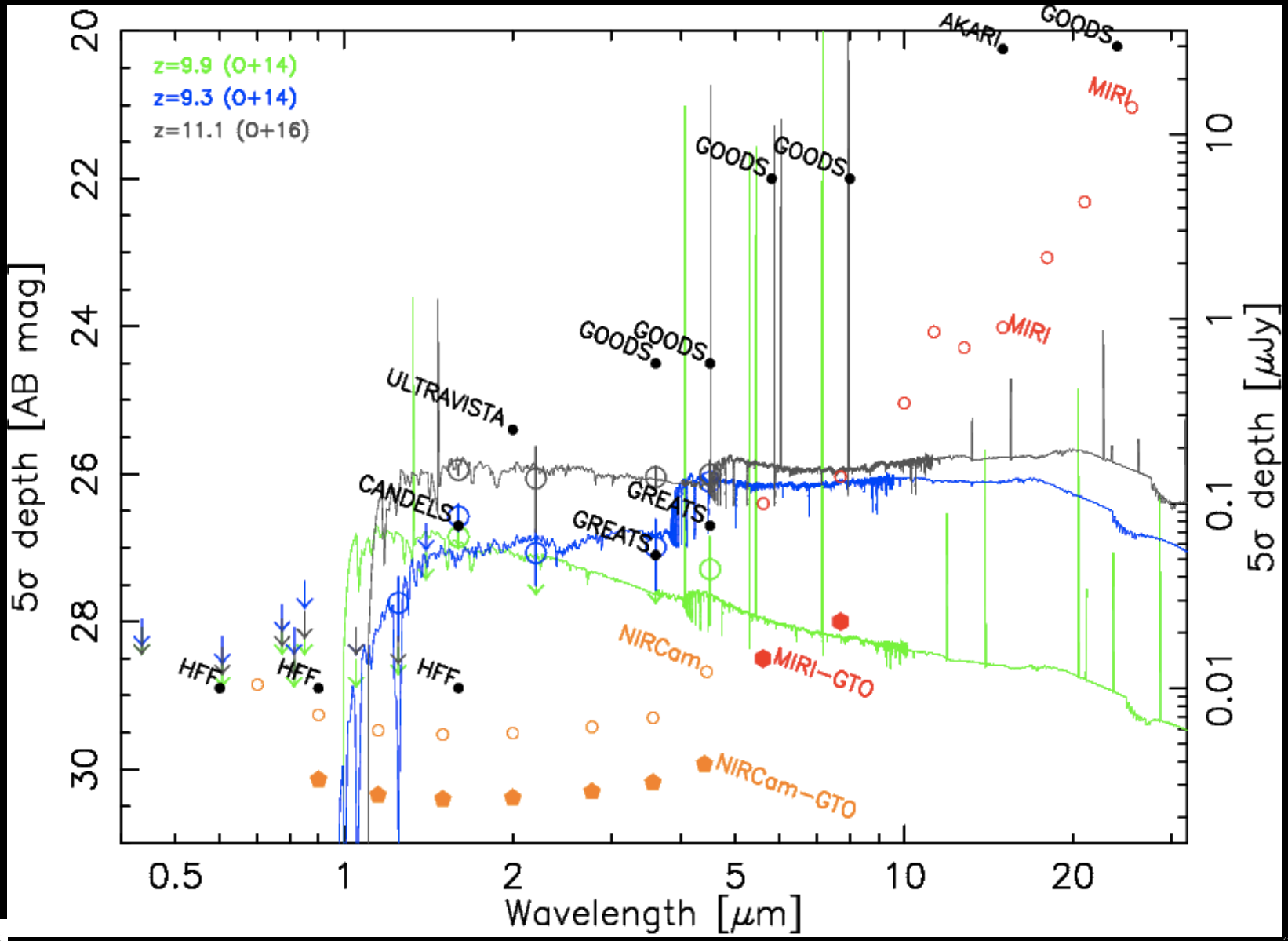
JWST imaging surveys with NIRCam+MIRI



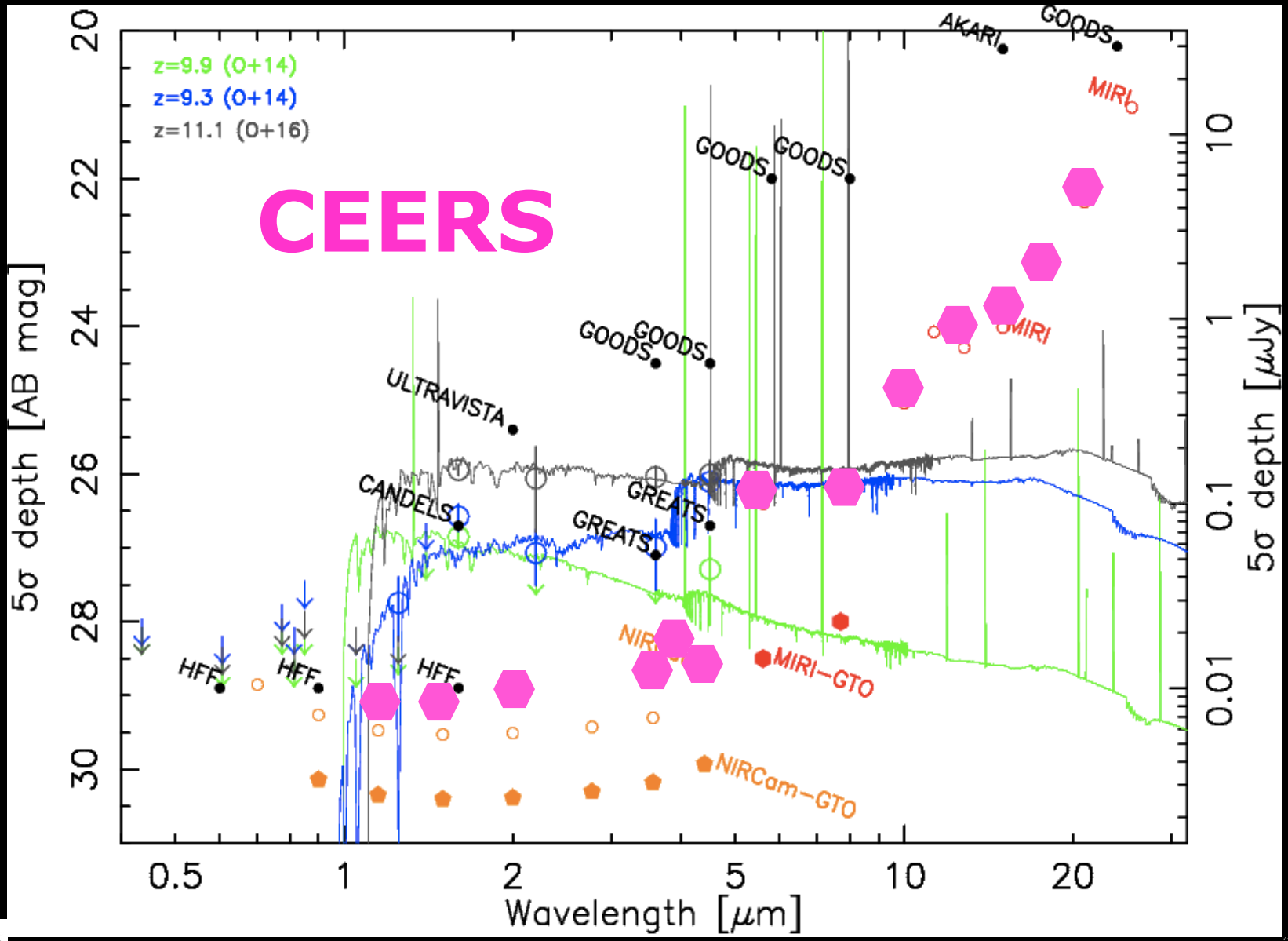
JWST imaging surveys with NIRCam+MIRI



JWST imaging surveys with NIRCam+MIRI



JWST imaging surveys with NIRCam+MIRI



CEERS Co-I's

	Investigator	Institution	Country
	M Dickinson	National Optical Astronomy Observatory, AURA	USA/AZ
	H Ferguson	Space Telescope Science Institute	USA/MD
PI	S Finkelstein	University of Texas at Austin	USA/TX
*	A Grazian	INAF, Osservatorio Astronomico di Roma	ITA
	N Grogin	Space Telescope Science Institute	USA/MD
*	L Pentericci	INAF, Osservatorio Astronomico di Roma	ITA
*	P Perez-Gonzalez	Universidad Complutense de Madrid	ESP
	N Pirzkal	Space Telescope Science Institute	USA/MD
	S Ravindranath	Space Telescope Science Institute	USA/MD
	R Somerville	Rutgers the State University of New Jersey	USA/NJ
	J Trump	University of Connecticut	USA/CT
*	S Wilkins	University of Sussex	GBR

Co-Investigators, together with the PI (and any Co-PIs) comprise a **core team** with the responsibility of developing and delivering science-enabling products as described in the proposal, as well as carrying out selected key aspects of the science investigations.

Number of investigators: 18

* ESA investigators: 4

CEERS Science collaborators

Name	Role	Institution	Email Address
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Taylor Hutchison			
Marc Huertas-Company			
Karthelk Iyer			
Jason Jaacks			
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Saurabh Jha			
Shardha Jogee			
Stephanie Juneau			
Intae Jung			
Susan Kassin			
Allison Kirkpatrick			
Peter Kurczynski			
Rebecca Larson			
Kyoung-Soo Lee			
Rachael Livermore			
Ray Lucas			
Kameswara Bharadwaj M			
Francesca Marchi			
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CEERS Full Proposal Team

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Andrea Grazian	Co-I	Osservatorio Astronomico di Roma	andrea.grazian@oa-roma.inaf.it
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Science Collaborators contribute to the formulation of the proposed observations and articulation of the full range of science applications enabled and may participate in core team activities, but do not have formal obligations to contribute to the development and delivery of science-enabling products.

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CEERS observational strategy (original)

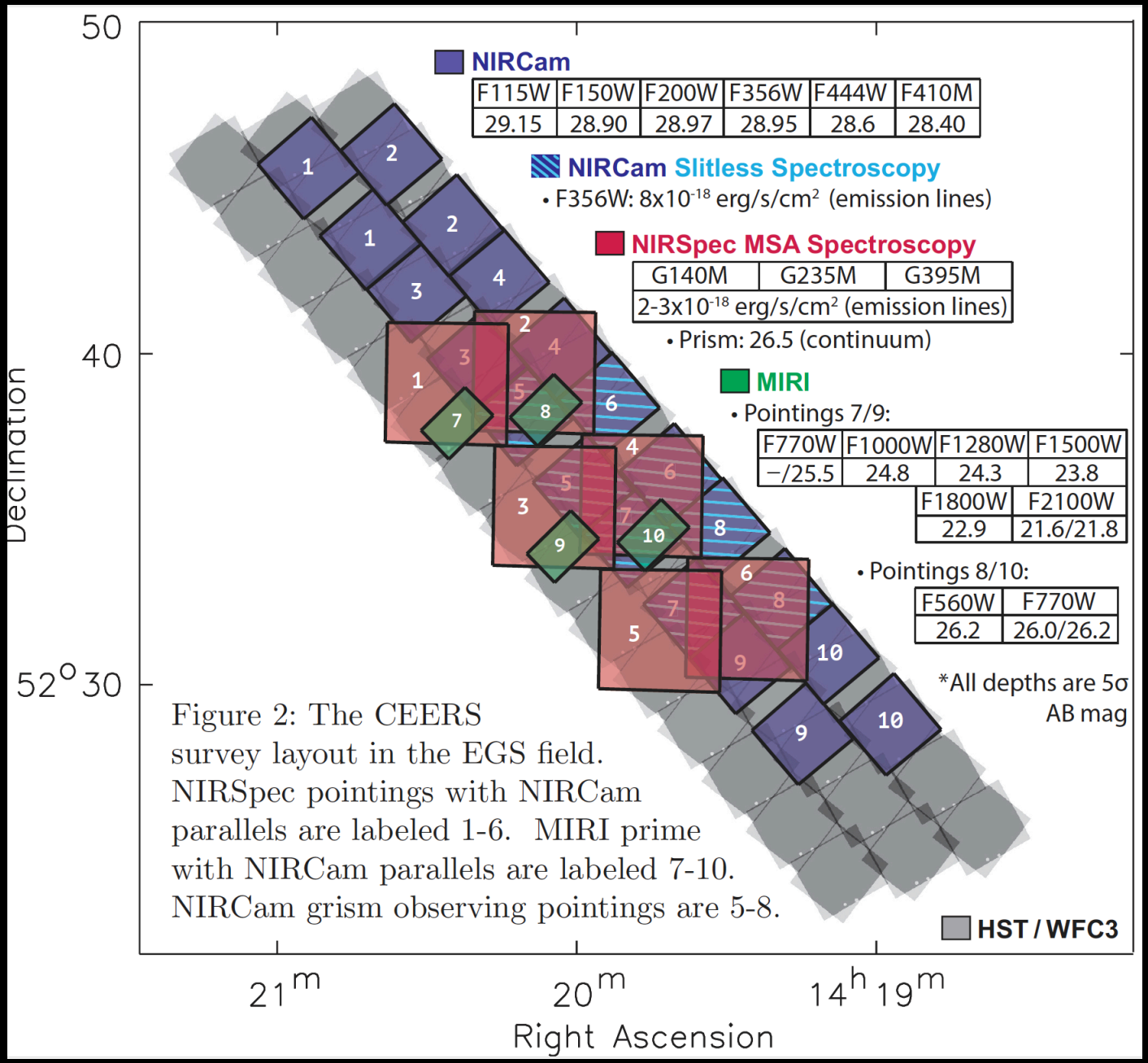
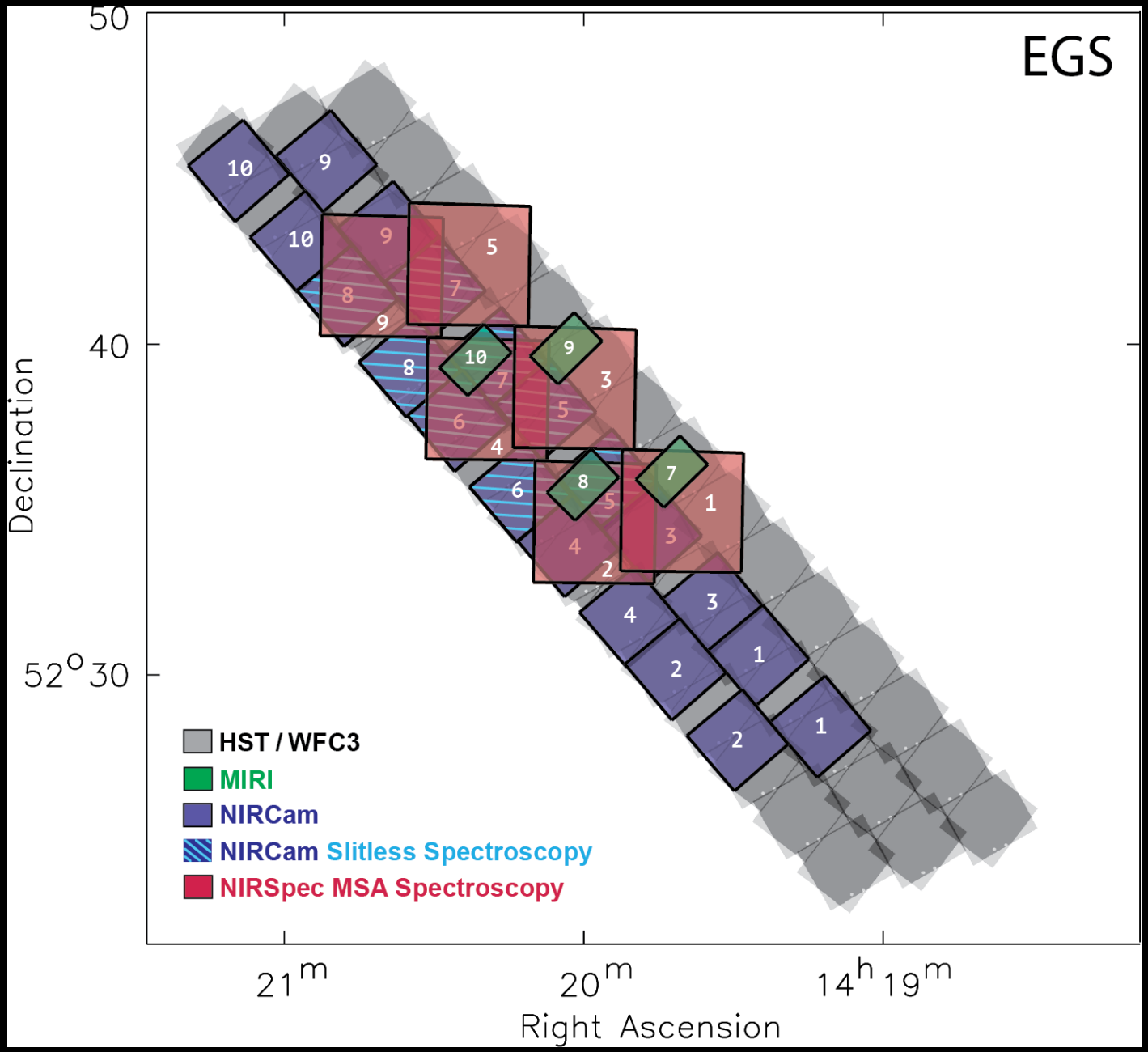
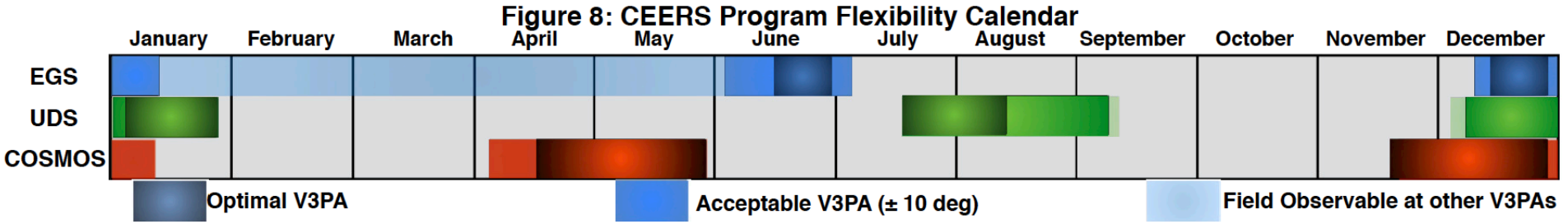


Figure 2: The CEERS survey layout in the EGS field. NIRSpec pointings with NIRCam parallels are labeled 1-6. MIRI prime with NIRCam parallels are labeled 7-10. NIRCam grism observing pointings are 5-8.

CEERS observational strategy (Nov 2017)



CEERS observational strategy: field alternatives

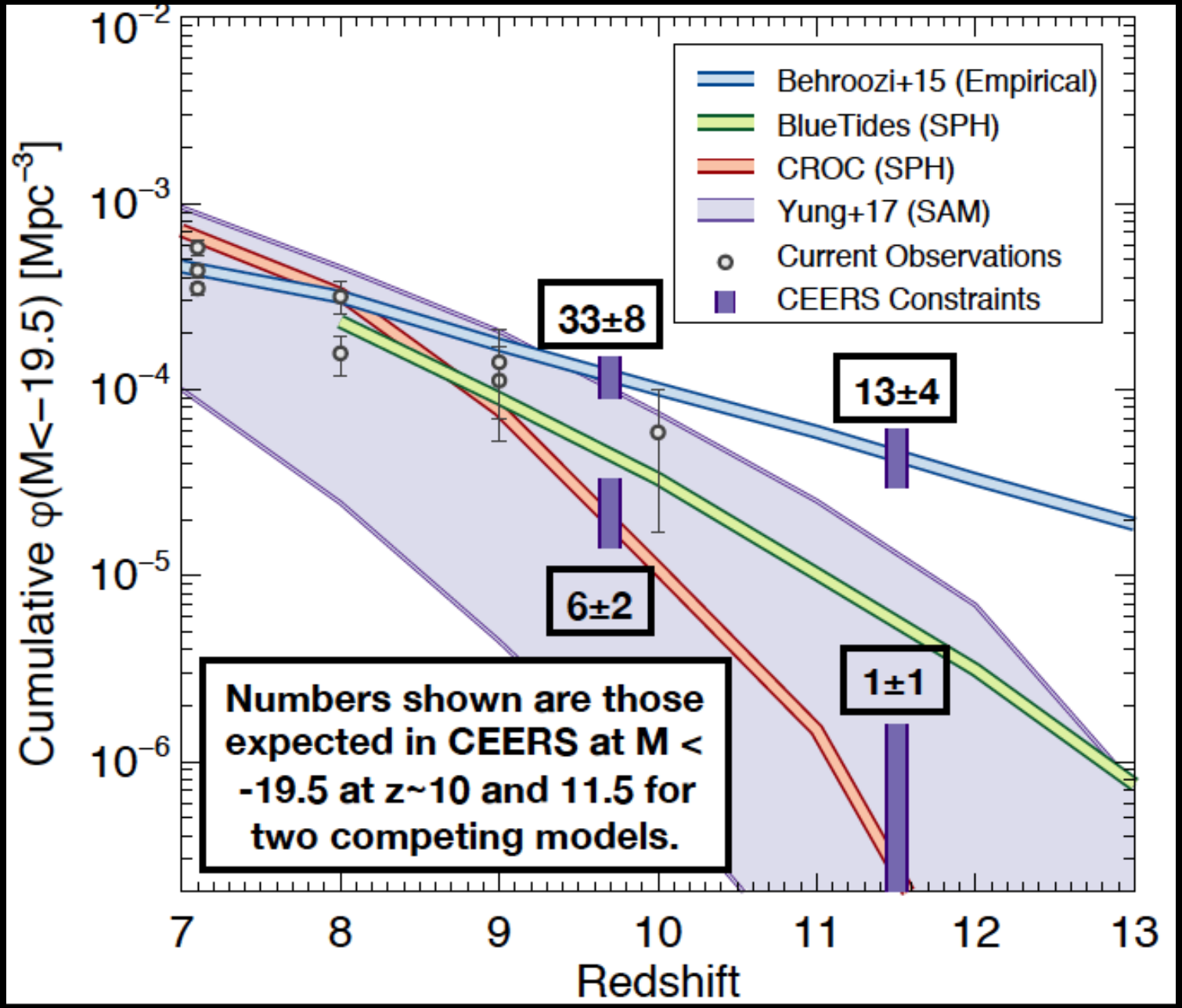


CEERS observational strategy

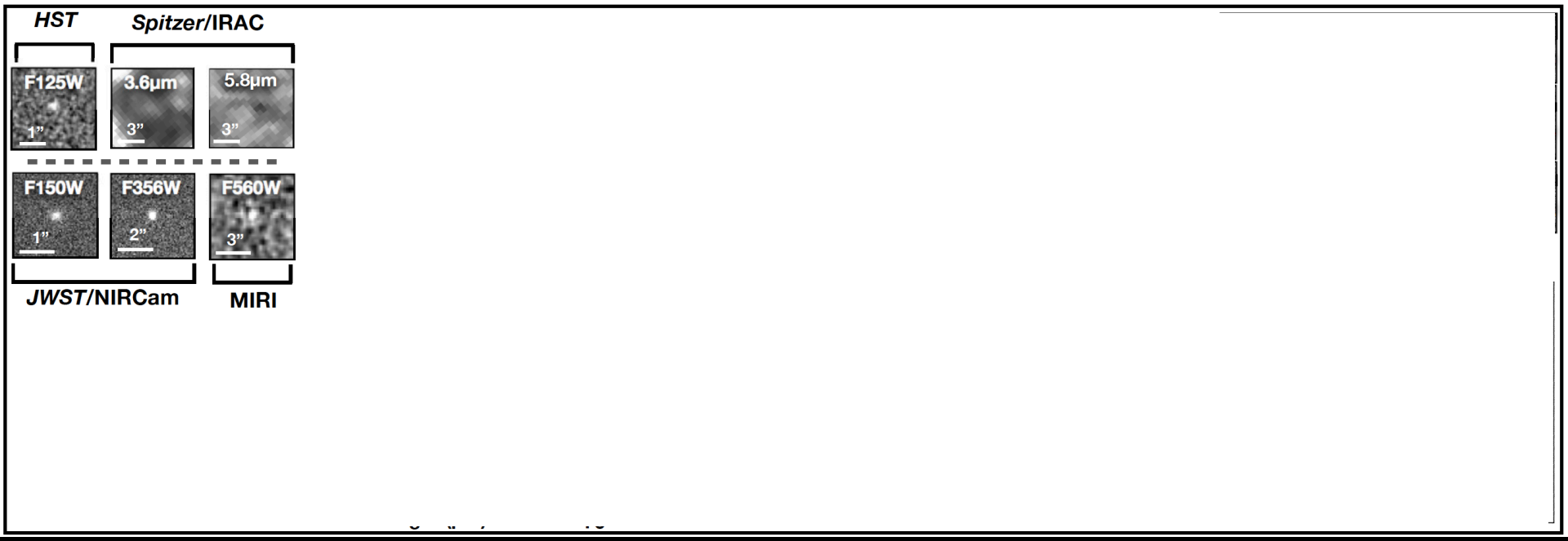
Table 2: CEERS Observing Strategy Drivers

Low-background, well-studied HST field, favorable geometry for parallels, easily scheduled ⇒ **EGS**
Maximize # of candidates 9<z<12 for Cycle 2 followup ⇒ **Deep-wide NIRCAM F115W, F150W & F200W**
Efficient spectral reconnaissance for cycle 2 ⇒ **NIRSpec R=100, 1000 and NIRCam Grism**
λ>5μm reconnaissance for cycle-2: targets, SEDs & morphology ⇒ **MIRI multi-band imaging**

CEERS science: very high-z candidates (NIRCam)



CEERS science: spectroscopy @ high-z (NIRSpec)



CEERS science:

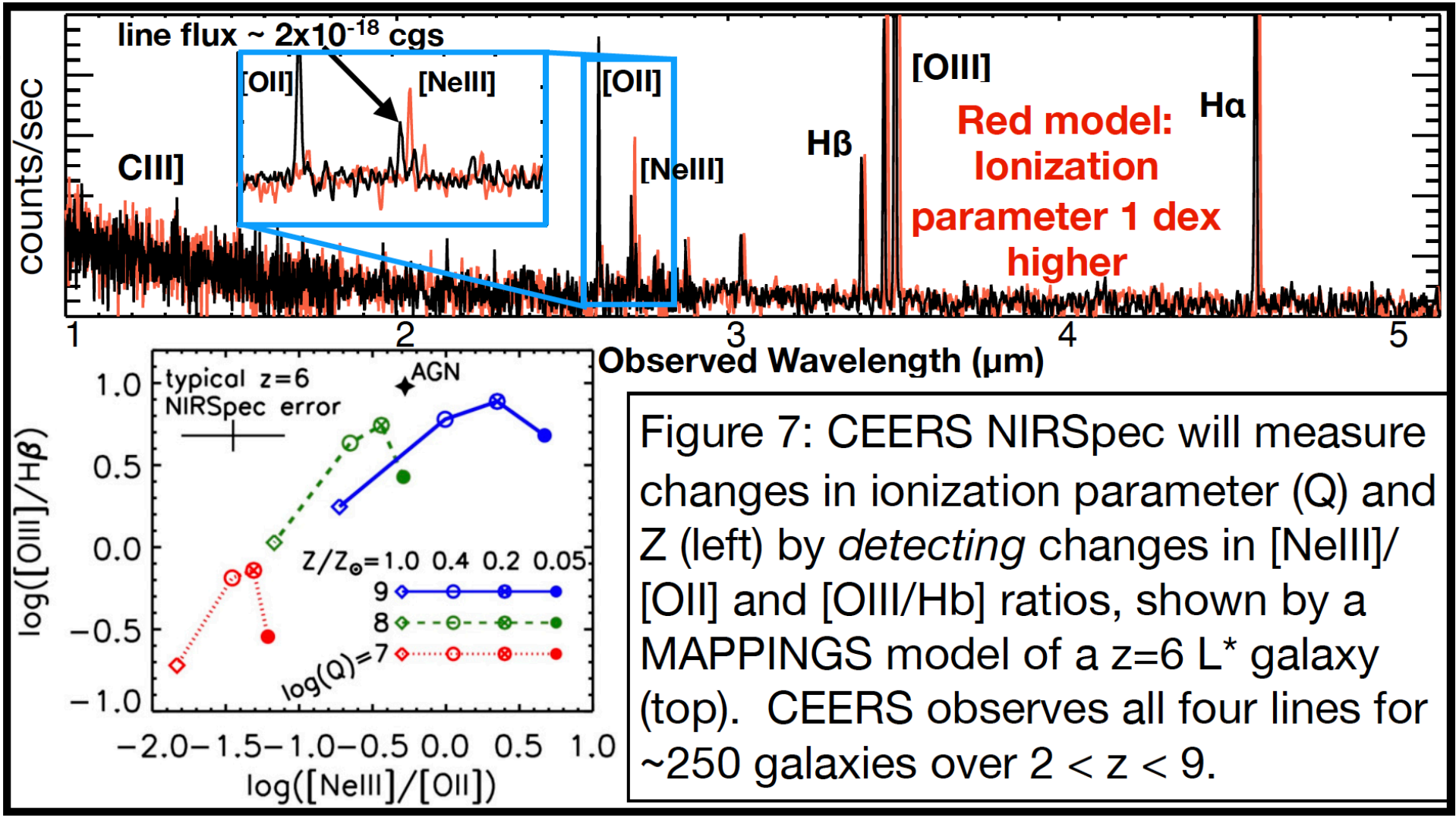


Figure 7: CEERS NIRSpec will measure changes in ionization parameter (Q) and Z (left) by *detecting* changes in [NeIII]/[OII] and [OIII/Hb] ratios, shown by a MAPPINGS model of a z=6 L* galaxy (top). CEERS observes all four lines for ~250 galaxies over 2 < z < 9.

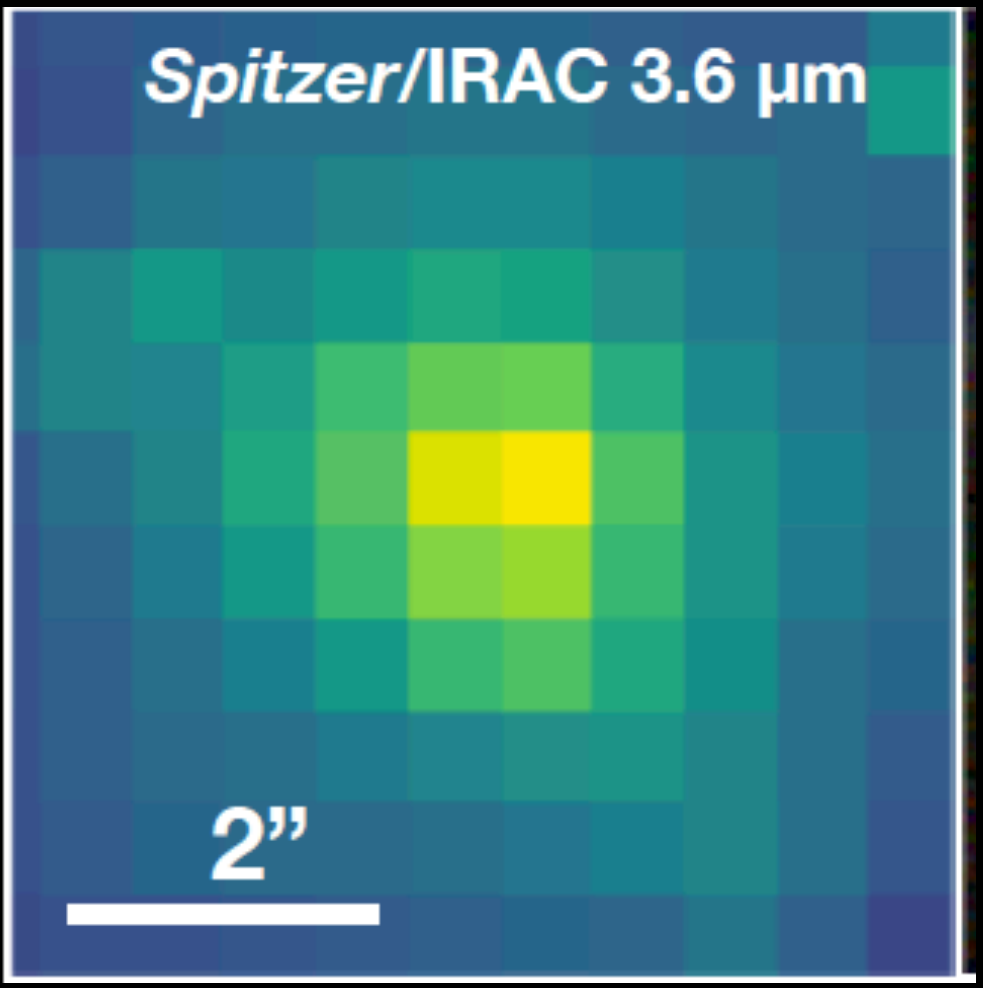
CEERS science:

Table 1: #Galaxies Observed by CEERS NIRSpec

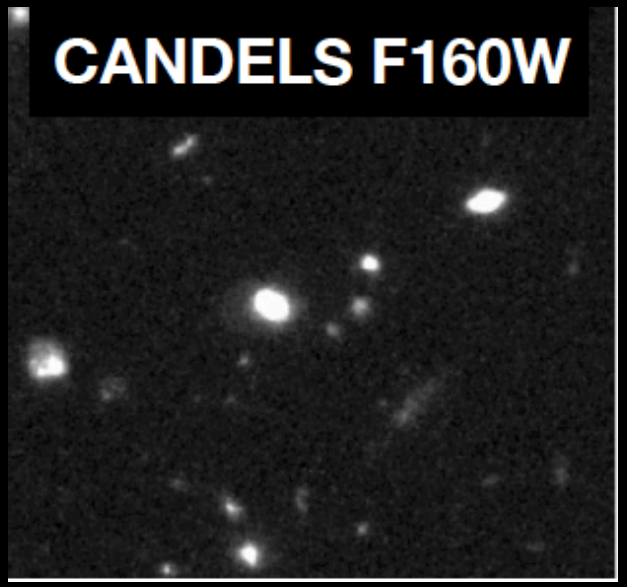
	All z	6 < z < 9	3 < z < 6	1 < z < 3
R~1000 (6 pointings)	330	32	97	161
R~100 (4 pointings)	299 (150)	27 (21)	82 (57)	150 (55)

* Numbers in parentheses are those covered at both R~100 and ~1000

CEERS science: rest-frame optical morphology z<9



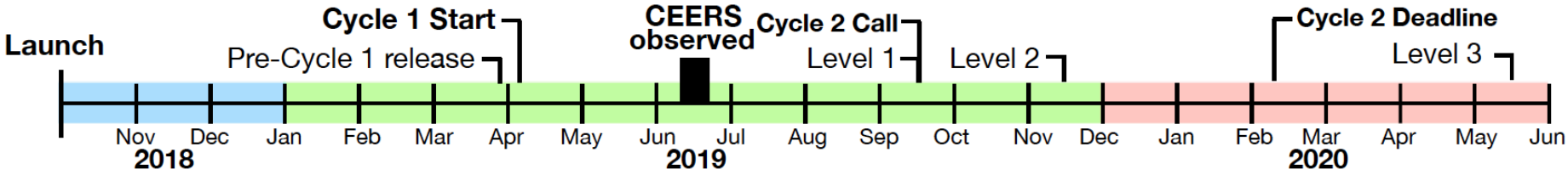
CEERS science: resolved (U)LIRGs at z<2



CEERS analysis plan

Table 3: CEERS Analysis Plan and Community Data Release Calendar

Assumes nominal Cycle 1 start of April 2019 and CEERS observations in June 2019; all data releases will shift commensurate with any observation delay



Data Release	Spectroscopy (NIRSpec MSA and NIRCam grism)	Imaging (NIRCam and MIRI)
Pre-Cycle 1	Interface with STScI to finalize observing design (*Grogin, Dickinson, Kocevski, Finkelstein*). Build and release simulated data for all CEERS observations; use to master and optimize data reduction pipelines (*all STScI Co-I's, Dickinson, Kartaltepe, Papovich, Somerville, Kewley, Finkelstein*). Produce and release improved *HST* ACS & WFC3 mosaics and catalogs (*Dickinson, Koekemoer, Finkelstein*). Design CEERS website and data interface; begin blog (*Finkelstein*). Participate in STScI briefings (*Finkelstein, Dickinson, Papovich, STScI Co-I's*), and CEERS-led briefings at predominantly underrepresented minority-serving institutions across US (*all Co-I's*).	
Level 1	**v0.5 Reduced 2D and 1D Spectra** *NIRSpec: Dickinson, Kartaltepe, Lotz & Ferguson* NIRCam Grism: *Pirzkal, Finkelstein & Trump*	**v0.5 Image mosaics** *NIRCam: Koekemoer & Finkelstein* MIRI: *Papovich & Perez-Gonzalez*
Level 2	1) v1 Reduced 2D and 1D Spectra 2) v1 Spectroscopy cat (line fluxes and spec-z): *Dickinson, Kartaltepe, Trump, Pentericci, Ravindranath, Pirzkal, Finkelstein*	1) v1 Image mosaics 2) v1 PSF-Matched Photometry cats: *HST*+NIRCam, MIRI: *Finkelstein, Ferguson, Papovich, Grazian, Perez-Gonzalez* 3) Release sample of z>9 candidates: *Finkelstein+team*
Level 3	1) v2 Reduced 2D and 1D Spectra 2) Publish v2 Spectroscopic Catalog *Dickinson, Kartaltepe, Trump, Pentericci* 3) Publication of NIRSpec slit-loss and MSA vs. grism scientific efficiency analysis: *Dickinson, Finkelstein, Pirzkal, Ferguson*	1) v2 Image mosaics 2) v2 EGS multi-wavelength cats (incl, photo-z, M*, SFR): *Finkelstein, Ferguson, Papovich, Grazian, Perez-Gonzalez, Wilkins, Pirzkal* 3) *F200W* Morphology catalogs (e.g., R_e, n_{Sersic}, Gini, M20): *Lotz, Kartaltepe, Kocevski*

Names given after each task denote the Investigator(s) who will lead each aspect, in collaboration with postdocs, students and/or RIAs under their supervision.

CEERS executive summary

Figure 1: CEERS Strategy Map

Goal

Demonstrate *efficient* JWST parallel survey exploration of the high-redshift universe

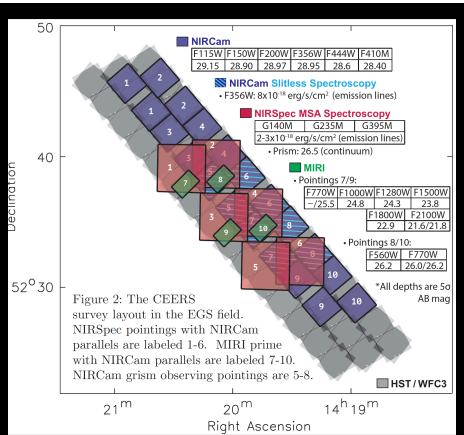
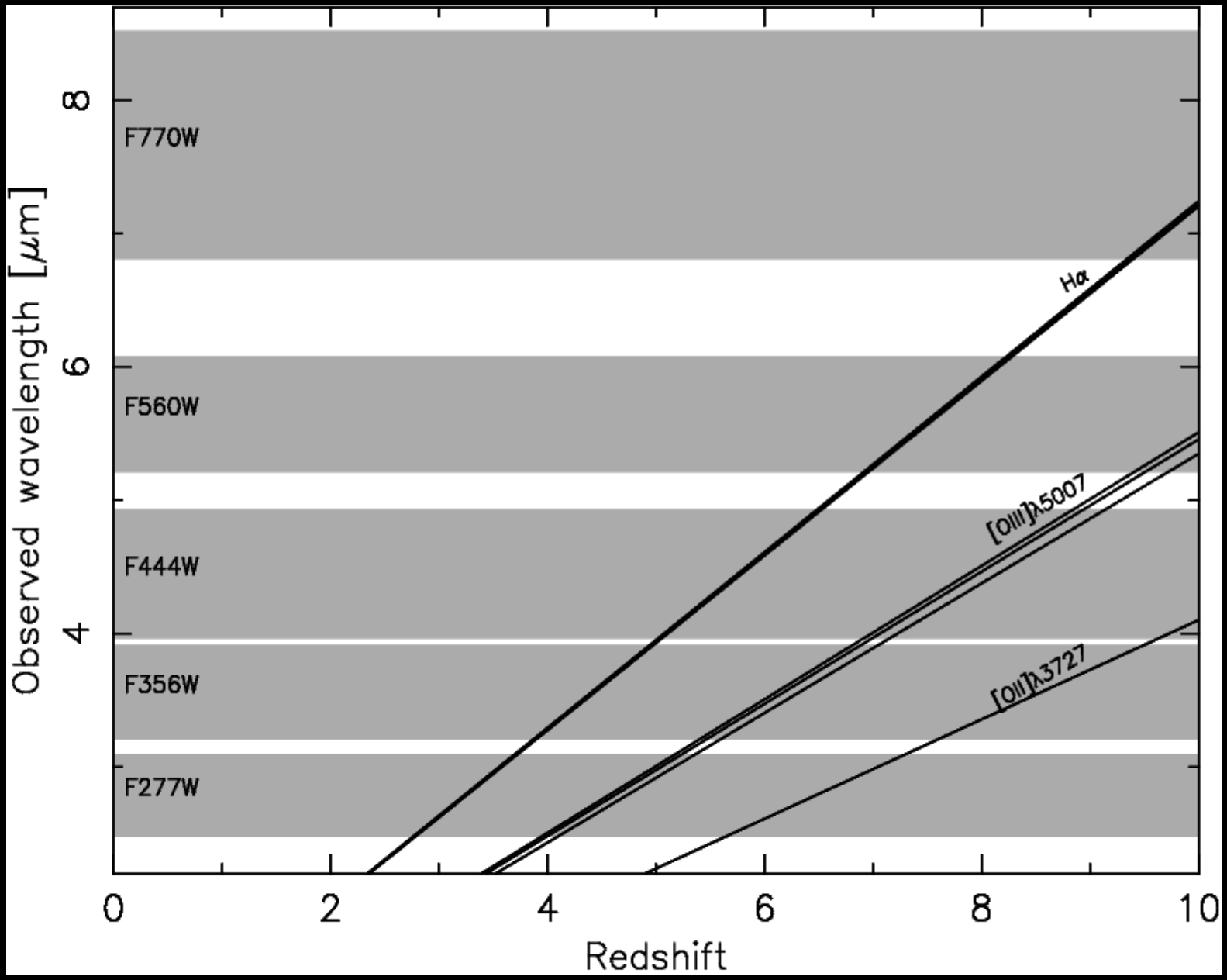


Figure 2: The CEERS survey layout in the EGS field. NIRSpec pointings with NIRCam parallels are labeled 1-6. MIRI prime with NIRCam parallels are labeled 7-10. NIRCam grism observing pointings are 5-8.

CEERS in Spain

2) Rest-frame near-IR fluxes for 5<z<8 sources



APT file

- **Download APT file: Retrieve from STScI, program 1345 (ERS, GTO)**
- **Check basic info: Proposal information**

  64.10 hours allocation, version (edit number), abstract
- **Check targets**

  8 fixed targets, 1 auto target (generated by MSA)), visit planner
- **Check observations**
  - **MIRI+NIRCam: 4 observations (pointings)**
    - **MIRI1 & MIRI3:**

      only one slew charged, data volume is small, 65-70% efficience, DEEP8
      - **MIRI: F560W (3 ks), F770W (9 and 6 ks), 3 pt dither**
      - **NIRCam: SH-F115W (3 and 6 ks), F150W (3 ks), F200W (3 ks)**
        LO-F277W (3 ks), F356W (3 ks), F410M (3 ks, only MIRI1), F444W (3 ks)
    - **MIRI2 & MIRI4:**
      - **MIRI: 1.7 ks in F770W (1 ptng), F1000W (2 ptng), F1280 (2 ptng), F1500W (2 ptng), F1800W (2 ptng); 3 ks (MIRI4) and 4.7 (MIRI2) ks in F2100W.**
      - **NIRCam: SH-F115W (3 and 5.8 ks), F150W (3 ks), F200W (3 ks)**
        LO-F277W (3 ks), F356W (3 ks, MIRI2), F410M (3 ks, MIRI2), F444W (3 ks)

APT file

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- **Check basic info: Proposal information**

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- **Check targets**

  8 fixed targets, 1 auto target (generated by MSA)), visit planner
- **Check observations**
  - **MIRI+NIRCam: 4 observations (pointings)**
  - **NIRCam grism: 4 observations (pointings)**
    - **NIRCam[3456] Grism:**

      only one slew charged, data volume is very small, 35-40% efficience, 3 visits, 4 subpixel position, both grism (C&R)

      • F356W grism (2x1.2 ks) and F115W direct image (2x1 ks)

APT file

- **Download APT file: Retrieve from StScI, program 1345**
- **Check basic info: Proposal information**

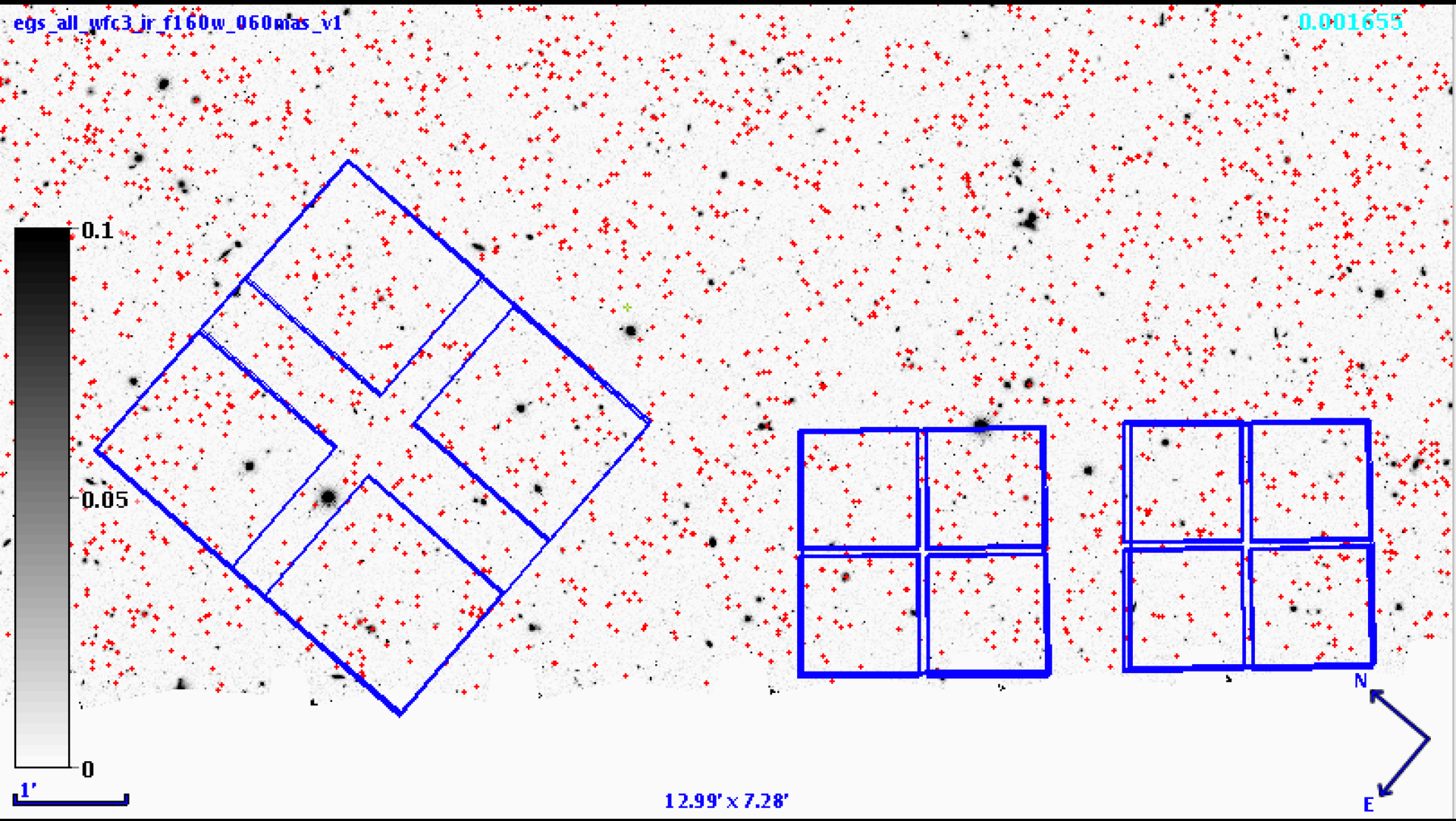
  64.10 hours allocation, version (edit number), abstract
- **Check targets**

  8 fixed targets, 1 auto target (generated by MSA), visit planner
- **Check observations**
  - **MIRI+NIRCam: 4 observations (pointings)**
  - **NIRCam grism: 4 observations (pointings)**
  - **NIRSpec+NIRCam: 1 observation (6 pointings)**
    - **Merged:**

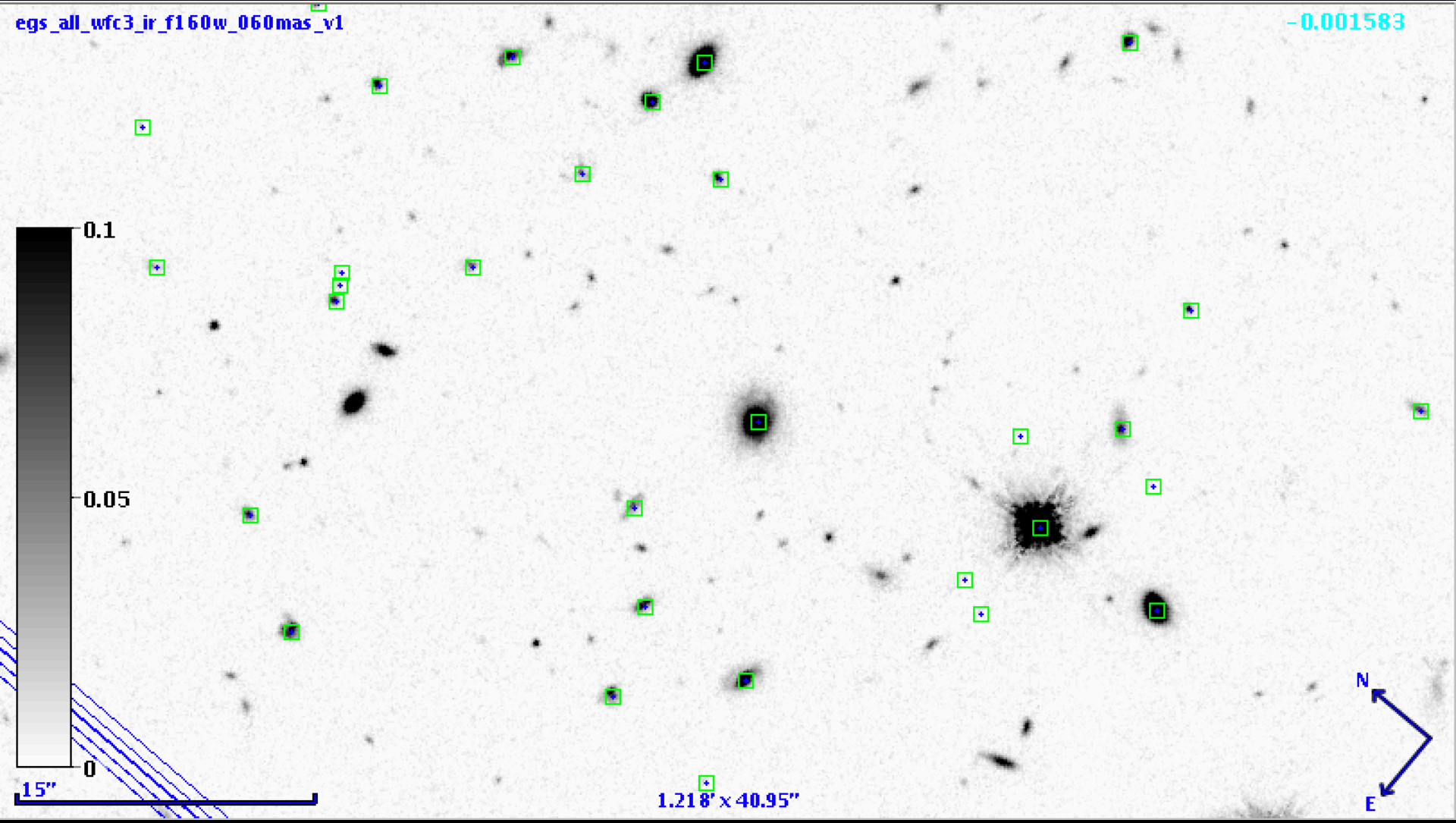
      No slew charged!!!, data volume is moderate, 60-65% efficience, 6 visits, check comments

      - **NIRCam: SH-F115W (6 ks), F150W (3 ks), F200W (3 ks)**
        LO-F277W (3 ks), F356W (3 ks), F410M (3 ks, 4 ptng), F444W (3 ks)
      - **NIRSpec: prism/clear, G140M/F100LP, G235M/F170LP, G395M/F290LP,**
        5354 sources in primary list, 36219 targets in filler list

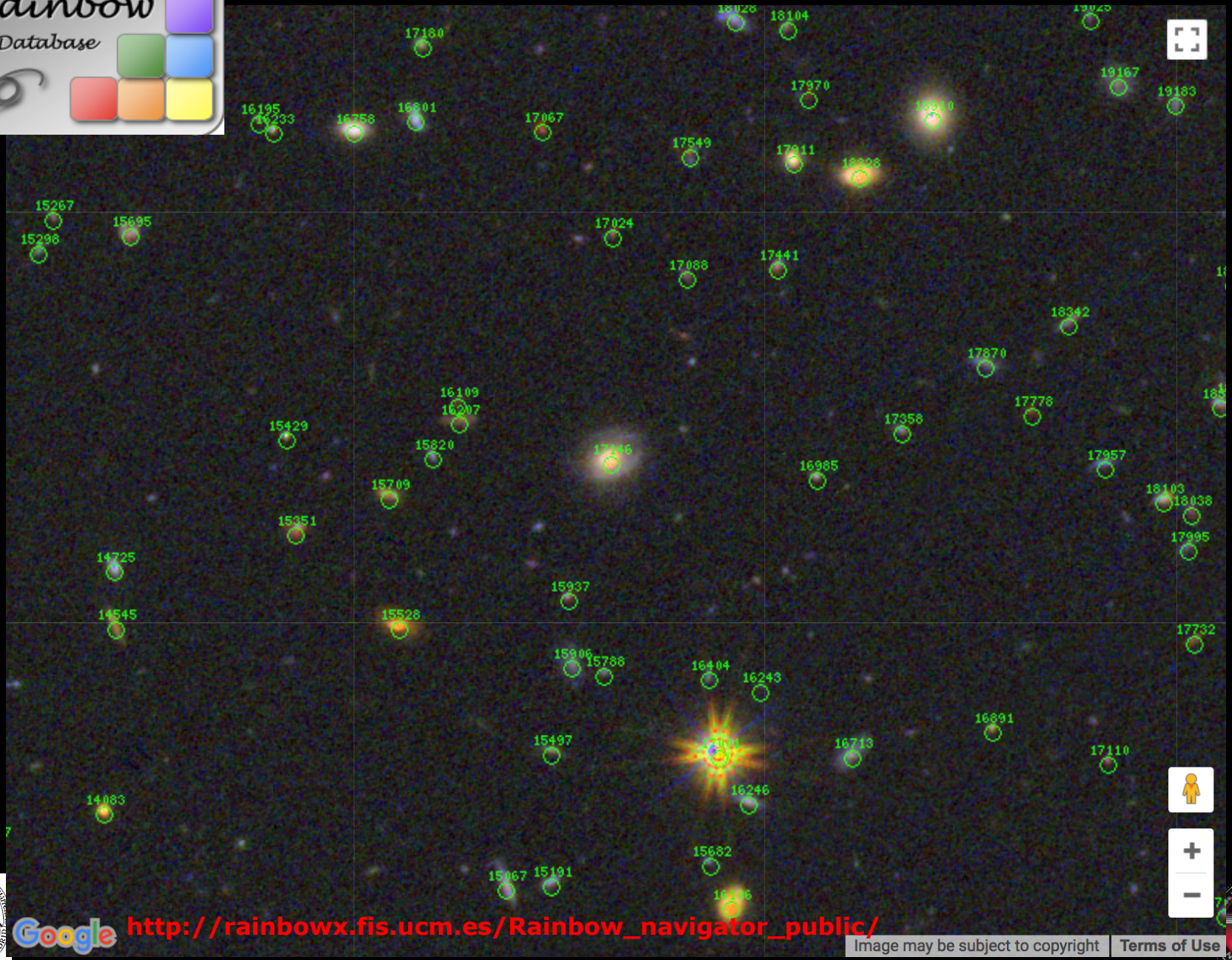
Targets for MSA



Targets for MSA



Targets for MSA



Rainbow Navigator

Choose field and selection band

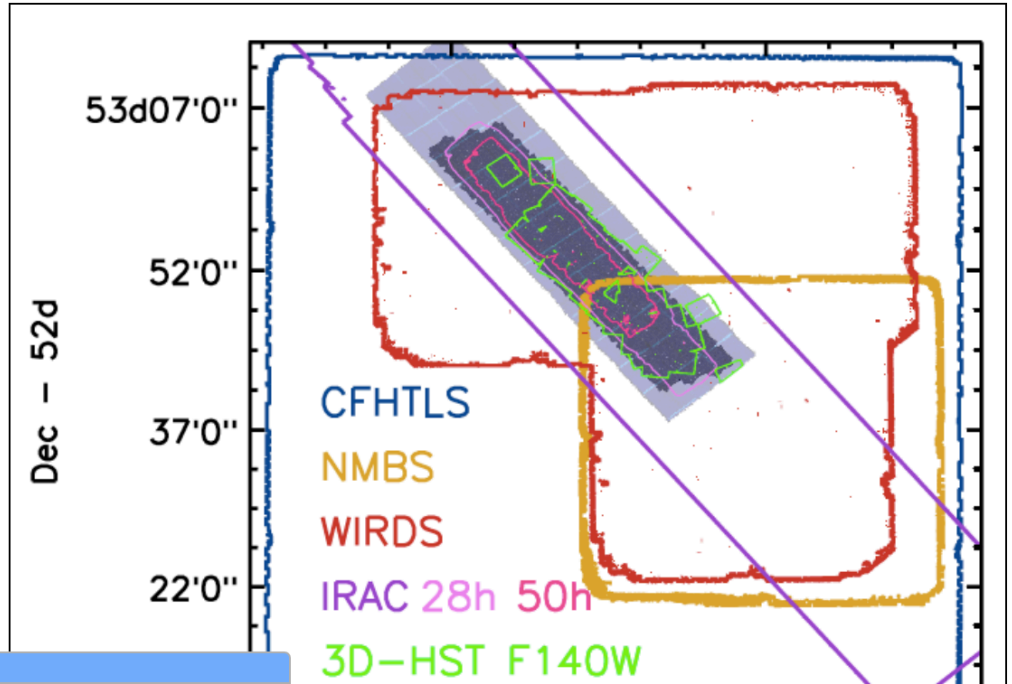
Select field (database) ?

EGS

Selection Band ?

CANDELS_F160W_DR1

Dataset footprints for selected Rainbow catalog



BUILD YOUR SAMPLE ?

Sample selection interface

SEARCH (BY COORDS) ?

RA (J2000.0)

DEC (J2000.0)

Search radius 2.

Query database

SEARCH (BY NAME) ?

Galaxy ID

Query database

CLICKABLE MAP ?

Central RA 14:19:58.83

DEC +52:56:10.4

Map size 2

Mark sources

Get map

JWST synthetic magnitudes in Rainbow database

K_Steidel			-1.e	m_obs_i_012	1.e+			-1.e	M_abs_rf_i_012	1.e+	
JWST_nircam_F070W			-1.e	m_obs_i_013	1.e+			-1.e	M_abs_rf_i_013	1.e+	
CFHTLS_i			-1.e	m_obs_i_014	1.e+			-1.e	M_abs_rf_i_014	1.e+	
Subaru_I			-1.e	m_obs_i_015	1.e+			-1.e	M_abs_rf_i_015	1.e+	
CFHTLS_z			-1.e	m_obs_i_016	1.e+			-1.e	M_abs_rf_i_016	1.e+	
ACS_z			-1.e	m_obs_i_017	1.e+			-1.e	M_abs_rf_i_017	1.e+	
JWST_nircam_F090W		☑	-1.e	m_obs_i_018	1.e+			-1.e	M_abs_rf_i_018	1.e+	
Hawkl_Ydet			-1.e	m_obs_i_019	1.e+			-1.e	M_abs_rf_i_019	1.e+	
JWST_nircam_F115W		☑	-1.e	m_obs_i_020	1.e+			-1.e	M_abs_rf_i_020	1.e+	
2mass_J			-1.e	m_obs_i_021	1.e+			-1.e	M_abs_rf_i_021	1.e+	
ISAAC_J			-1.e	m_obs_i_022	1.e+			-1.e	M_abs_rf_i_022	1.e+	
JWST_nircam_F150W			-1.e	m_obs_i_023	1.e+			-1.e	M_abs_rf_i_023	1.e+	
2mass_H			-1.e	m_obs_i_024	1.e+			-1.e	M_abs_rf_i_024	1.e+	
ISAAC_H			-1.e	m_obs_i_025	1.e+			-1.e	M_abs_rf_i_025	1.e+	
JWST_nircam_F200W			-1.e	m_obs_i_026	1.e+			-1.e	M_abs_rf_i_026	1.e+	
ISAAC_K			-1.e	m_obs_i_027	1.e+			-1.e	M_abs_rf_i_027	1.e+	
2mass_K			-1.e	m_obs_i_028	1.e+			-1.e	M_abs_rf_i_028	1.e+	
JWST_nircam_F277W			-1.e	m_obs_i_029	1.e+			-1.e	M_abs_rf_i_029	1.e+	
IRAC_36			-1.e	m_obs_i_030	1.e+			-1.e	M_abs_rf_i_030	1.e+	
JWST_nircam_F356W			-1.e	m_obs_i_031	1.e+			-1.e	M_abs_rf_i_031	1.e+	
JWST_nircam_F444W			-1.e	m_obs_i_032	1.e+			-1.e	M_abs_rf_i_032	1.e+	
IRAC_45			-1.e	m_obs_i_033	1.e+			-1.e	M_abs_rf_i_033	1.e+	
JWST_miri_F560W		☑	-1.e	m_obs_i_034	1.e+			-1.e	M_abs_rf_i_034	1.e+	
IRAC_58			-1.e	m_obs_i_035	1.e+			-1.e	M_abs_rf_i_035	1.e+	
JWST_miri_F770W			-1.e	m_obs_i_036	1.e+			-1.e	M_abs_rf_i_036	1.e+	
IRAC_80			-1.e	m_obs_i_037	1.e+			-1.e	M_abs_rf_i_037	1.e+	
JWST_miri_F1000W			-1.e	m_obs_i_038	1.e+			-1.e	M_abs_rf_i_038	1.e+	
JWST_miri_F1130W			-1.e	m_obs_i_039	1.e+			-1.e	M_abs_rf_i_039	1.e+	

(35) [8:48] mac_laptop: /Users/pgperez> less Desktop/online_table_errors_104_ztype.lst

Checking numbers with the ETC

- **NIRCam imaging:**

  PSF: https://jwst-docs.stsci.edu/display/JTI/NIRCam+Point+Spread+Functions

  - **F115W: (5x1x3)x2 (2886x2 s)**

    29.15 mag (flat continuum), point source, 0.040” PSF FWHM, 0.080” aperture radius, 0.7”-0.9” sky

  - **F150W: 5x1x3 (2886 s)**

    28.90 mag (flat continuum), point source, 0.050” PSF FWHM, 0.100” aperture radius, 0.7”-0.9” sky

  - **F444W: 5x1x3 (2886 s) or (3x1x3)x2 (3156 s)**

    28.60 mag (flat continuum), point source, 0.145” PSF FWHM, 0.145” aperture radius (+aperture correction), 1.2”-1.5” sky

  - **F410M (3x1x3)x2 (3156 s)**

    28.40 mag (flat continuum), point source, 0.137” PSF FWHM, 0.137” aperture radius, 1.2”-1.5” sky

- **NIRCam grism: 2x1x8 (2490 s)**

  8e-18 CGS line with different widths, point source, 0.15” aperture half height, 0.5”-0.8” sky, C vs R grisms!

Checking numbers with the ETC

MIRI:

https://jwst-docs.stsci.edu/display/JTI/MIRI+Imaging

- **F560W: 360x1x3 (2997 s)**

  26.2 mag (flat continuum), point source, 0.22” PSF FWHM, 0.22” aperture radius, 1.5”-1.8” sky

- **F770W: 360x1x9 (8991 s)**

  26.2 mag (flat continuum), point source, 0.25” PSF FWHM, 0.25” aperture radius, 1.5”-1.8” sky

- **F1000W: 100x2x3 (1665 s)**

  24.8 mag (flat continuum), point source, 0.32” PSF FWHM, 0.32” aperture radius, 1.5”-1.8” sky

- **F2100W: 36x10x3 (2997 s)**

  21.8 mag, 7 μJy (flat continuum), point source, 0.67” PSF FWHM, 0.67” aperture radius, 2.0”-2.5” sky

Checking numbers with the ETC

- **NIRSpec**
  - **G140M/F100LP 13x1x3 (2889 s)**
    26.5 mag (flat continuum)+ 2-3x10^{-18} CGS line
  - **G235M/F170LP: 13x1x3 (2889 s)**
    26.5 mag (flat continuum)+ 2-3x10^{-18} CGS line
  - **G395M/F290LP: 13x1x3 (2889 s)**
    26.5 mag (flat continuum)+ 2-3x10^{-18} CGS line
  - **Prism/clear: 13x1x3 (2889 s)**
    26.5 mag (flat continuum)+ 2-3x10^{-18} CGS line